Observational Study

Incidence of Cervicogenic Headache Following Lower Cervical Radiofrequency Neurotomy

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Background: The facet joints contribute to chronic cervical spine pain in an estimated 55% of chronic neck pain cases and can be treated with percutaneous radiofrequency neurotomy (PRN). Damage to surrounding structures during treatment or successful treatment of the primary pain source leading to unmasking could lead to new onset of pain, including cervicogenic headache (CGH). In this study, we aimed to define the incidence of headache in patients who have been previously treated with PRN for lower cervical facet pain.

Setting: All patients treated at a single academic institution's pain management clinic from 2014 to 2016 with cervical PRN were reviewed.

Methods: All patients treated at a single institution's pain management clinic from 2014 to 2016 were reviewed. Those treated with lower cervical PRN were identified, and incidence of CGH was described as a percentage of the study population. Patient age and pain scores between those with and without headaches following treatment were compared by unpaired T-tests. Gender, presence of comorbid disease and levels involved, quality of pain, exacerbating and alleviating factors, location of referred pain, and previous treatments between those with and without headaches following treatment were compared using chi-square tests.

Results: Among the 88 patients in the study group, 12 were found to have only moderate relief of their pretreatment pain as well as a new onset headache meeting the diagnostic criteria for cervicogenic headache. Compared to those without a headache after treatment, those diagnosed with cervicogenic headache were more likely to be female ($P = 0.041$), report a higher maximum pain level on presentation ($P = 0.015$), have a diagnosis of diabetes prior to presentation ($P = 0.011$), and have had the procedure performed at levels which included C3 ($P = 0.013$) (Table 1).

Limitations: The limitations of this study include its single-center design, as this cohort may not be truly representative of the population of patients receiving cervical PRN as a whole, and as a result, these results may not be generalizable. Due to the small size of the cohort, more subtle differences in presenting signs and symptoms between those with and without headaches may not be detectable. Finally, as previously mentioned, the lack of data on some of the patients who presented with headache may have led to underdiagnosis of the true incidence of cervicogenic headache. Future work should look to re-examine the incidence of CGH in a larger cohort to validate the findings here and further define risk factors for post-procedural CGH.

Conclusions: This retrospective review of all patients seen over 2 years in an academic pain clinic found a 13.6% incidence of cervicogenic headache following cervical radiofrequency neurotomy at levels C3-C7. This supports the possibility of the unmasking phenomenon following the procedure, though contributing mechanisms underlying this phenomenon may be multifactorial and require further study.

IRB: This study was approved by the institution's Institutional Review Board (IRB2010601795).

Key words: Cervical spine, facetogenic pain, percutaneous radiofrequency neurotomy, cervicogenic headache, chronic pain, zygapophysial joints, innervation convergence, retrospective chart review

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According to the US National Center for Health Statistics national health interview survey (1), 15% of adults have experienced recent neck pain. In another large survey (2), 34.4% of the respondents had experienced neck pain within the last year, and 13.8% reported neck pain that lasted for more than 6 months. Neck pain is a common condition that causes substantial disability. Of all 291 conditions studied in the Global Burden of Disease 2010 Study (3), neck pain ranked fourth-highest in terms of disability as measured by years lived with disabilities, and 21st in terms of overall burden.

Neck pain can be caused by dysfunction of many different structures of the cervical region such as nerves, muscles, intervertebral disks, and facet joints. Assessment of cervical facetogenic pain can be complicated by significant variability and convergence in the innervation patterns related to the sensory distribution of the cervical medial branch nerves (4). The facet or zygapophysial joints, which are innervated by the medial branches of the dorsal rami (5), are estimated to contribute to chronic cervical spine pain in about 55% of all cases (6). Percutaneous radiofrequency neurotomy (PRN) introduces probes through the skin and overlying soft tissues to generate friction, using thermal energy to ablate the medial branch nerves via a conducting element. PRN has been shown to be a valid treatment for zygapophyseal pain (7). Mechanical or thermal injuries of these structures during treatment could lead to new onset of pain, including cervicogenic headache (CGH) (4). Multiple structures within the cervical spine could simultaneously be sources of pain after an injury or due to chronic degenerative changes. Treatment of one source of neck pain could lead to unmasking or even perceived exacerbation of nociception from other pain generators (8). No studies to date have examined the relationship between PRN and new-onset, post-procedure headache.

In this retrospective cohort study, we aimed to define the incidence of headache in patients who have been previously treated with percutaneous radiofrequency neurotomy for lower cervical zygapophyseal pain and identify its causes, associated symptoms, risk factors, and frequency of pertinent comorbid conditions.

Methods

This single-center study included a review of all patients treated at a single academic center's pain management clinic with 4 providers from 2014 to 2016 identified with Current Procedural Terminology codes 64633 and 64634. Over this period, 326 individuals were identified with these codes. Inclusion criteria were age over 18 years and documentation of follow-up after the procedure. Exclusion criteria were diagnosis of chronic headache condition prior to presentation at the clinic, acute headache on presentation, or treatment of levels other than C3-C7. All patients were de-identified prior to inclusion in the database. Basic demographic information, etiology, headache characteristics, any previous chronic pain or headache history, other treatments, and follow-up were recorded. CGH was diagnosed based on the criteria outlined by the International Headache Society's classification of headache disorders (10). Incidence of CGH was described as percentage of the population meeting all inclusion and exclusion criteria. Patient age and pain scores between those with and without headaches following treatment were compared by unpaired T-tests. Gender, presence of comorbid disease, cervical levels involved, quality of pain, exacerbating and alleviating factors, location of referred pain, and previous treatments between those with and without headaches following treatment were compared using chi-square tests. Patients in the study cohort were compared to all patients receiving lower cervical PRN to test for heterogeneity in the study population. All statistical analysis was done with JMP 12.0 (SAS Institute, Cary, NC). This project was done with approval from the institution's institutional review board (IRB2010601795).

Results

From 2014 to 2016, 326 patients met the search criteria using the Current Procedural Terminology codes, 184 were disqualified because they were treated at another level besides C3-C7, and 55 more were excluded because of chronic headache conditions or acute headache on presentation. Eighty-eight patient met inclusion/exclusion criteria (Fig. 1). Qualifying patients were compared to all patients receiving lower cervical PRNs with no significant differences in demographics, pain level on presentation, medical comorbidities, or treatment history (Table 1). Among the 88 patients in the study group, 12 were found to have a new onset unilateral headache worse with movement following their lower cervical PRN (Fig. 2). All had complete relief of their new onset headache with a diagnostic block C2/C3 in 4 patients, C2/TON/C3 in 5 patients, and greater and lesser occipital nerve blocks (GON/LON) in 3 patients, which were followed by treatment with percutaneous radiofrequency lesioning in the cases of

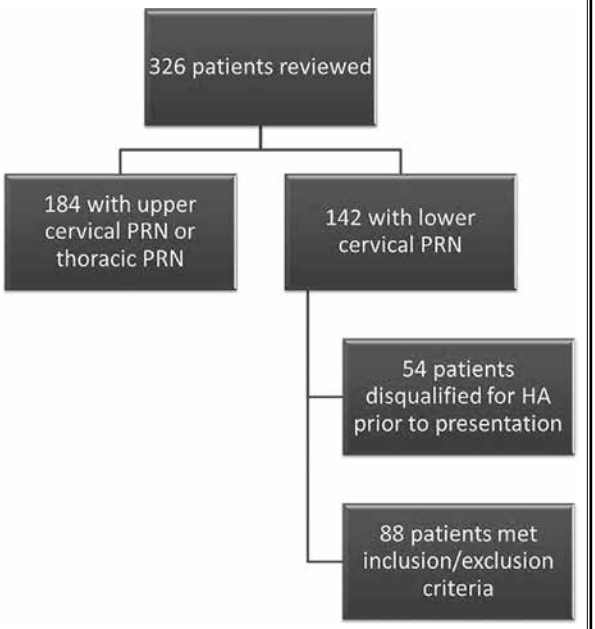

Fig. 1. *Of 326 records reviewed, 108 were treated with lower cervical PRN, with 45 individuals disqualified for headache on presentation.*

those patients with positive diagnostic C2/C3 and C2/TON/C3 blocks. An additional 10 patients were noted to have new onset headache following PRN that did not meet the criteria for cervicogenic headache.

Table 1. *Baseline characteristics of study population compared to all patients receiving lower cervical PRN. There were no significant differences in the study population compared to all patients receiving lower cervical PRN.*

	Qualifying patients	All lower cervical RFLs	*P*
Measure	(n = 88)	(n = 143)	
Age, mean ± SD	57.2 ± 13.8	55.2 ± 13.7	0.293
Percent female	60.00	63.40	0.606
Average pain level (0-10)	6.33 ± 1.91	6.51 ± 1.74	0.563
Average duration of pain	5.92 ± 7.78	6.96 ± 9.12	0.406
Anxiety	21.40%	26.20%	0.397
Depression	29.20%	33.30%	0.512
Substance abuse	13.50%	11.40%	0.631
Obesity	33.70%	40.70%	0.285
Diabetes mellitus	11.20%	12.10%	0.85
C3 level treated	33.30%	30.50%	0.652

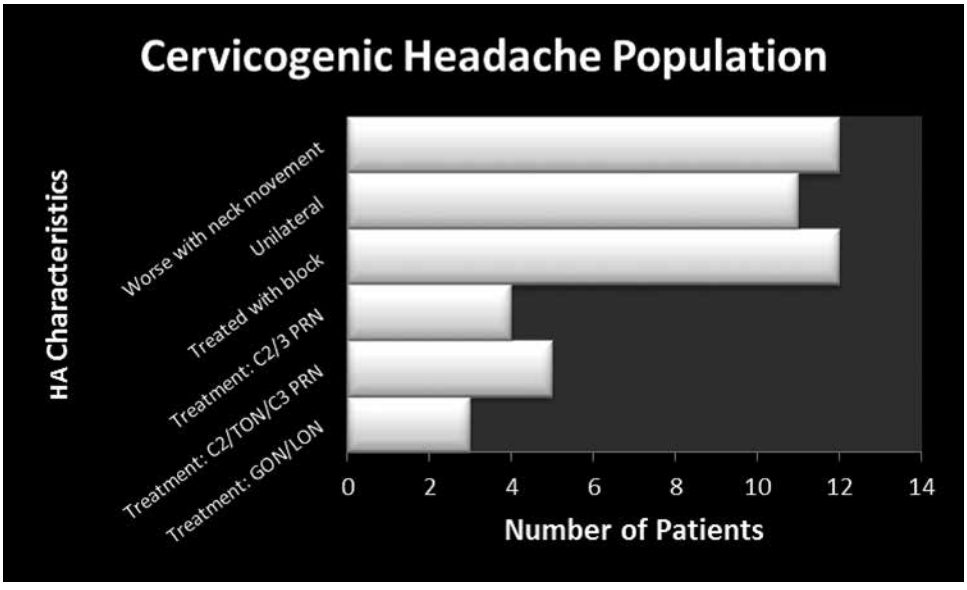

Fig. 2. *Characteristics of CHG cohort after treatment with lower cervical PRN. All had exacerbation with neck movement and complete relief with diagnostic block including C2/3 PRN, C2/TON/C3 PRN and GON/LON blocks. Those with relief of headache following C2/3 and C2/TON/C3 blocks were subsequently treated with PRN at those levels.*

When compared to those without a headache after treatment (Table 2), those diagnosed with cervicogenic headache were more likely to be female (P = 0.041), report a higher maximum pain level on presentation (P = 0.015), have a diagnosis of diabetes prior to presentation (P = 0.011), and have had the procedure performed at levels which included C3 (P = 0.013) (Table 1). There was also a tendency for those without new onset headache post PRN treatment to report neck pain exacerbation with exercise and improvement with rest prior to treatment in contrast to those who developed new onset headache post-PRN treatment, who reported no improvement of their baseline neck pain with rest and improvement with exercise more frequently (Fig. 3).

Discussion

This retrospective review of all patients seen over 2 years in an academic pain clinic found a 13.6% incidence of cervicogenic headache following cervical radiofrequency neurotomy at levels C3-C7. This phenomenon has been previously described in individual patients (7,11,12), though no previous study has defined its incidence in this cohort. The rates of cervicogenic headache in the general population have been previously described as 0.4 to 4.5% of the general population (13-16), though this number may be as high as 33.8% in the cohort of chronic pain patients (17). Based on these estimates, the results found here seem reasonable. In the context of other adverse effects of percutaneous cervical radiofrequency neurotomy, the incidence described here is relatively low (post-procedural pain, cutaneous numbness, ataxia, and dysesthesia were found to occur in greater than 60% of all patients undergoing cervical PRN in two small cohorts) (18,19). Because of this comparably low occurrence, providers could consider counseling patients about cervicogenic headache in pre-procedural discussions of informed consent. Additionally, our reported success rate is below some previously published reports (7,11,18). PRN was performed on individuals with less than 100% response to diagnostic blocks, which may account for this difference (20-22). Finally, it is important to note that an additional 11% of patients in this cohort reported headaches that did not meet criteria for cervicogenic headache. Some of these individuals were diagnosed with migraine headaches, caffeine withdrawal headache, or tension type headache while others had incomplete records or were lost to follow-up. Some in this group may have had unrecognized CGH leading to an underdiagnosis of the true incidence. Other individuals in this group presenting with post-procedural headaches other than CGH indicate a significant proportion of patients presenting with post-cervical PRN headache and should be approached with a broad differential diagnosis.

The underlying mechanism of this could be direct or indirect. Many of the structures in and around the zygapophyseal joint can be irritated as a result of the procedure itself. Neck pain, as noted above, is commonly worsened after the procedure. Irritation of convergent areas in the neck could result in new-onset cervicogenic headache. Alternatively, a significant proportion of patients in this cohort sustained traumatic neck injuries (many in motor vehicle accidents) as the presumed etiology of their pain. This mechanism of injury could lead to injuries of multiple structures within the cervical spine with facetogenic pain predominating over other minor sources of pain until treated. Once

Table 2. *Comparison of patient characteristics in the cervicogenic headache group compared to those who did not experience headache. Significant differences were found in sex, severity of pain, presence of diabetes, and treatment of the C3 level (statistically significant different responses in italics, most common response bolded).*

	Cervicogenic HA	**Negative control**	*P*
Patient characteristics	(n = 12)	(n = 76)	
Sex	67% female	36% female	0.041
Quality of pain	Aching, sharp, stabbing, shooting, dull	Aching, sharp, shooting stabbing, dull, electric shock, throbbing	
Severity of pain	7.08 average	6.21 average	0.105
	9.0 max	7.93 max	0.0151
Exacerbating factors	Neck movements, lifting	Neck movements, exercise, sitting, standing	
Alleviating factors	Medications (NSAIDs, topical treatments, opioids, SSRI/SNRI), exercise, heat, PT, massage	Medications (NSAIDs, opioids), rest, PT, activity modification, heat	
Diabetes mellitus	33.30%	8.00%	0.011

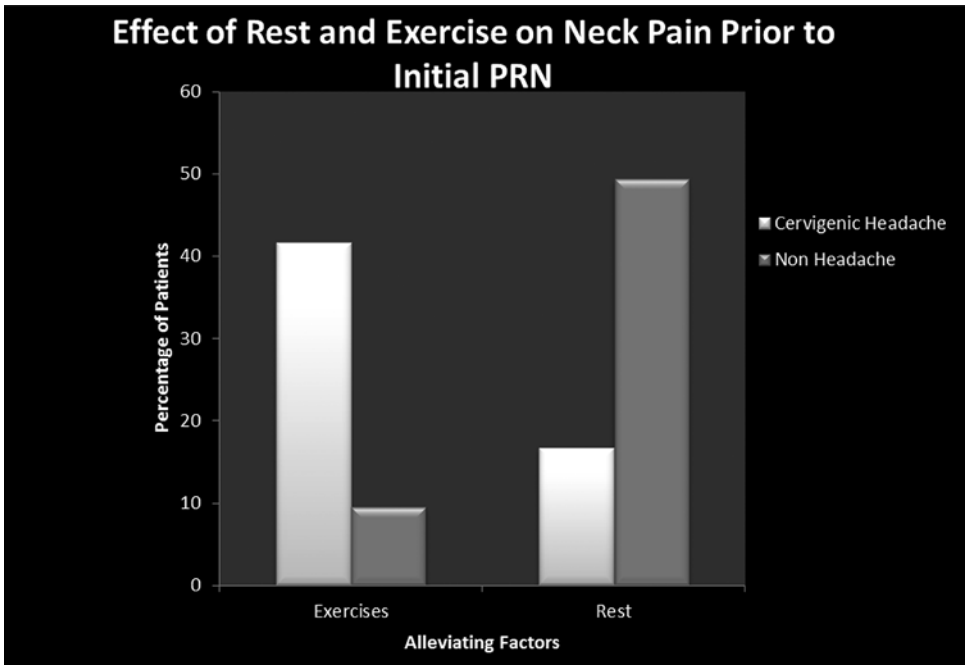

Fig. 3. *Comparison of pre-presentation alleviating factors with a predominance toward improvement in pain with exercise in the CHG group and a predominance toward improvement of pain with rest in the non-headache group.*

the predominant pain source has been addressed, the patient might perceive other pain generators. Finally, the patient could have had a preexisting C2/C3 nerve irritation from another cause such as cervical spondylosis that was masked by new onset pain from another source. Such irritation could be unmasked or exacerbated by treatment. It is important to note that no previous studies have included treatment at the C3 level for "lower cervical" radiofrequency neurotomy. As this study aimed to examine the effect of treatment of neck and shoulder pain on development of cervicogenic headache, treatments that included C3 level for such symptoms were included. We found that 5 of 37 individuals (13.5%) treated at levels C4 to C7 experienced cervicogenic headache, which is consistent with the findings of the larger cohort, though treatment at C3 may have contributed to an alternate mechanism of postprocedural headache as noted above. Half of the patients (6 of 12) were treated with a block which did not overlap with the treatment they originally received prior to headache onset, which seems to support the latter mechanism. The rest had at least some overlap in site of treatment, making it more difficult to discern the underlying mechanism.

Patients with CGH in this cohort were more likely to be female and have a non-throbbing headache, which are minor diagnostic criteria of CGH based on the International Headache Society's definition and fitting with prior findings of CGH cohorts (9,10,23). Additionally, there was an association with increased pain at presentation (significantly higher maximum reported pain score and trend toward higher average pain scores) and CGH following neurotomy. Greater pain from lower cervical facet joints would be more likely to mask a secondary pain generator and may be indicative of a patient at higher risk of this complication on presentation. Additionally, CGH patients reported a moderate therapeutic benefit of exercise and no benefit of rest in improving their pain prior to cervical PRN compared to the rest of the cohort, which reported a moderate response to rest and no benefit of exercise. One previous report demonstrated the efficacy of exercise in the treatment of CGH (24), though the patients in this cohort did not endorse headaches prior to cervical PRN. Finally, there was an association of diabetes with the risk of developing CGH. To our knowledge, there has been no previous association of diabetes with increased likelihood of unmasking secondary pain. Diabetes has

been associated with chronic pain, even in those patients with non-neuropathic pain (25), suggesting that the proinflammatory state in diabetes may play a role in the increased likelihood of irritation of convergent pain generators or in greater baseline pain, which could increase the incidence of the masking phenomenon.

Limitations

The limitations of this study include its single-center design, as this cohort may not be truly representative of the population of patients receiving cervical PRN as a whole, and as a result, these results may not be generalizable. Due to the small size of the cohort, more subtle differences in presenting signs and symptoms between those with and without headaches may not be detectable. Finally, as previously mentioned, the lack of data on some of the patients who presented with headache may have led to underdiagnosis of the true incidence of cervicogenic headache. Future work should look to re-examine the incidence of CGH in a larger cohort to validate the findings here and further define risk factors for post-procedural CGH.

Conclusion

This retrospective cohort study demonstrates cervicogenic headache following radiofrequency neurotomy in a subset of patients and supports the possibility of the unmasking phenomenon following these procedures. Contributing mechanisms underlying this phenomenon may be multifactorial and require further study.

References

1. National Health Interview Survey, 2005-2010. [Internet]; available from: https://www.cdc.gov/nchs/nhis/nhis_2010_data_release.htm.
2. Bovim G, Schrader H, Sand T. Neck pain in the general population. *Spine* 1994; 19:1307-1309.
3. Hoy D, March L, Woolf A, Blyth F, Brooks P, Smith E, Vos T, Barendregt J, Blore J, Murray C, Burstein R, Buchbinder R. The global burden of neck pain: Estimates from the global burden of disease 2010 study. *Ann Rheum Dis* 2014; 73:1309-1315.
4. Bogduk N. Cervicogenic headache: Anatomic basis and pathophysiologic mechanisms. *Curr Pain Headache Rep* 2001; 5:382-386.
5. Bogduk N. The clinical anatomy of the cervical dorsal rami. *Spine* 1982; 7:35-45.
6. Manchikanti L, Boswell MV, Singh V, Pampati V, Damron KS, Beyer CD. Prevalence of facet joint pain in chronic spinal pain of cervical, thoracic, and lumbar regions. *BMC Musculoskelet Disord* 2004; 5:15.
7. Lord SM, Barnsley L, Wallis BJ, McDonald GJ, Bogduk N. Percutaneous radiofrequency neurotomy for chronic cervical zygapophyseal-joint pain. *N Engl J Med* 1996; 335:1721-1726.
8. Chin ML. Head, neck, and back pain. In: Vadivelu N, Urman RD, Hines RL (eds). *Essentials of Pain Management*. Springer, New York 2011, pp 567-584.
9. Sjaastad o, Fredriksen TA, Pfaffenrath V. Cervicogenic headache: Diagnostic criteria. *Headache* 1998; 38:442-445.
10. International Headache Society. The International Classification of Headache Disorders, 2nd edn. *Cephalalgia* 2004; 24(Suppl 1):115-116.
11. McDonald GJ, Lord SM, Bogduk N. Long-term follow-up of patients treated with cervical radiofrequency neurotomy for chronic neck pain. *Neurosurgery* 1999; 45:61-68.
12. Lord SM, McDonald GJ, Bogduk N. Percutaneous radiofrequency neurotomy of the cervical medial branches: A validated treatment for cervical zygapophysial joint pain. *Neurosurg Q* 1998; 814:288-308.
13. Nilsson N. The prevalence of cervicogenic headache in a random population sample of 20-59 year olds. *Spine* 1995; 20:1884-1888.
14. Sjaastad O, Fredriksen TA. Cervicogenic headache: Criteria, classification and epidemiology. *Clin Exp Rheumatol* 2000; 18(2 Suppl 19):S3-S6.
15. Sjaastad O, Bakketeig LS. Prevalence of cervicogenic headache: Vågå study of headache epidemiology. *Acta Neurologica Scandinavica* 2008; 117:173-180.
16. Knackstedt H, Bansevicius D, Aaseth K, Grande RB, Lundqvist C, Russell MB. Cervicogenic headache in the general population: The Akershus study of chronic headache. *Cephalalgia* 2010; 30:1468-1476.
17. Fishbain DA, Cutler R, Cole B, Rosomoff HL, Rosomoff RS. International Headache Society headache diagnostic patterns in pain facility patients. *Clin J Pain* 2001; 17:78-93.
18. Govind J, King W, Bailey B, Bogduk N. Radiofrequency neurotomy for the treatment of third occipital headache. *J Neurol Neurosurg Psychiatry* 2003; 74:88-93.
19. Lord SM, Barnsley L, Bogduk N. Percutaneous radiofrequency neurotomy in the treatment of cervical zygapophysial joint pain: A caution. *Neurosurgery* 1995; 36:732-739.
20. Royal M, Wienecke G, Movva V, Ward S, Bhakta B, Jensen M, Gunyea I. Retrospective study of efficacy of radiofrequency neurolysis for facet arthropathy. *Pain Med* 2001; 2:248-249.
21. Gevargez A, Braun M, Schirp S, Weinsheimer PA, Groenemeyer DH. Chronisches, nichtradikuläres HWS-Syndrom. *Schmerz* 2001; 15:186-191.
22. Shin WR, Kim HI, Shin DG, Shin DA. Radiofrequency neurotomy of cervical medial branches for chronic cervicobrachialgia. *J Korean Med Sci* 2006; 21:119-125.
23. Biondi DM. Cervicogenic headache: A review of diagnostic and treatment strategies. *J Am Osteopathic Assoc* 2005; 105:16S-22S.
24. Jull G, Trott P, Potter H, Zito G, Niere K, Shirley D, Emberson J, Marschner I, Richardson C. A randomized controlled trial of exercise and manipulative therapy for cervicogenic headache. *Spine* 2002; 27:1835-1843.
25. Mäntyselkä P, Miettola J, Niskanen L, Kumpusalo E. Chronic pain, impaired glucose tolerance and diabetes: A community-based study. *Pain* 2008; 137:34-40.